Herder Mental Stocking Rate in the Rangeland Regions of Northern China

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Abstract. In 2002, the Chinese government issued the "balancing animals and grass" policy to control the degradation problem of northern China, but these programs have been widely resisted by herders. We proposed that herder had their mental stocking rate, which refers to the number of animals that the herders think they can place or maintain on a piece of rangeland over a specified period of time. It is the mental stocking rate that guides herder on how to adjust livestock-breeding practices. This study surveyed herder opinion of grass-animal balance in the meadow steppe, typical steppe and desert steppe regions of northern China. Most herders admitted that they bred more livestock than ten years ago, whereas they insisted that there was no overstocking in their rangelands and more than half even thought that their rangelands could still carry more livestock when the policy was implemented. Most herders hold that they took into account the carrying capacity of rangelands when making decisions about stock-breeding practices. Herders from three regions nominated the following mental stocking rates; 0.75-1.50, 0.60-1.50, and 0.50-0.75 sheep/ha, insisting these rates were necessary and reasonable.

Keywords: Carrying capacity, decision behaviour, overgrazing, adaptive management.

Introduction

China has vast areas of grassland resources, accounting for 42% of the national land area (Ren *et al.* 2008). However, 90% of useable grasslands are degraded because of over-population, over-grazing, improper reclamation and adverse effects of droughts exacerbated by climate change (Li 1999; Li *et al.* 2008). Many studies have showed that the lower stocking rates are necessary for rehabilitating the degraded grassland (Kemp and Michalk 2007). In 2002, the Chinese government introduced "balancing animals and grass" policy (hereafter refereed to as "the policy") as a means to remediate grassland degradation. However, these programs are commonly resisted by herders (Li and Zhang 2009; Wang 2010) leading to an outcome best described as a "partial improvement amidst overall deterioration." The reasons for apparent failure of the policy have been discussed by Yang and Hou (2005) and Waldron *et al.* (2010), but little research has been focused on herder decision-making behaviour regarding the balance between livestock and forage resources.

Under the Household Contract Responsibility System (HCRS), herders are responsible for managing China's grasslands and their decisions have both direct and indirect impact on the balance between animal needs and forage supply. Herders hold that because they have lived in pastoral areas for generations, they better understand the grassland carrying capacity and condition, and can use their experience to identify "reasonable" stocking rate which we define as the "herder mental stocking rate". This stocking rate guides herders to take adaptive measures such as leasing grassland and buying forage to balance their livestock needs with feed supply (Hou 2005; Hou *et al.* 2012). To develop more effective policies and programs to reduce grassland degradation, a better understanding of how the herders use mental stocking rates to guide management to balance livestock needs and feed supply is urgently needed.

Methods

Study area

The study area included Xinbaerhu Left Banner, Xilinhot and Sunite Right Banner which were selected to represent meadow steppe, typical steppe and desert steppe, respectively (Table 1). Since the HCRS has been in place since the 1980s in these three regions, households own livestock and hold grazing rights through contracts. Livestock production from grazing native vegetation is the primary income of households. Year-long grazing is the main source and cheapest feed source of livestock feed in these three counties. Due to the high cost of buying forage, herders conserve some forage, but insufficient reserves mean that households heavily depend on the rangeland in

Table 1: Site location, Rangeland type, rangeland area (ha), useable rangeland area (ha), per capital net income (RMB), mean annual temperature (°C, 1980–2011), and mean annual precipitation (mm, 1980–2011).

Site	Rangeland type	Rangeland	Usable rangeland	Per capita net income	Annual temperature	Annual precipitation
Xinbaerhu	meadow steppe	1.94×10^6	1.79×10^6	9101	0.22	274.07
Xilinhot	typical steppe	1.49×10^6	1.38×10^6	9587	2.98	258.73
Sunite	desert steppe	2.58×10^6	2.37×10^6	5140	5.49	194.63

Note: the data of per capita net income is from the Inner Mongolia Statistical Yearbook in 2010.

winter and early spring. Under this situation, livestock number/household is strongly positively related with grassland resources owned by herder.

Survey of households

Preliminary visits and interviews in 15 Gachas (villages) in each of the three counties were conducted in May-September 2010. During June and September 2011, the study recruited 90 herders to identify the important issues regarding mental stocking rate and herder decision-making behaviour for their livestock enterprise. During July-September 2012, the survey based on the issues identified was conducted in villages from these three counties. Pastoral agriculture is the primary income of households in each village. We used a random-stratified sampling procedure, 10-20 households were randomly selected from 4-5 Gachas, which belong to 3 Sumus (township) in proportion to its total household numbers. A total of 180 herders, aged 40 years or older, were interviewed.

Results

Proposal of mental stocking rate

To better understand the process of overgrazing and identify feasible solutions for China's temperate grasslands, Kemp *et al.* (2011) used the relationship between animal production and stocking rate for grazing livestock (Fig. 1). Figure 1 shows that production/head decreases as stocking rate increases due to the decline in the quantity and quality of forage available per head. In turn, production/ha will initially increase and then begin to decrease reflecting the law of diminishing returns. Either side of the biological maximum there are two stocking rates (A or B in Fig. 1) that produce the same product output. For Chinese grasslands stocking rates are most often to the right of biological maximum because policy has focused on livestock number rather than production efficiency as the drive for household profitability. Han *et al.* (2011), Takahashi and Jones (2011) and Michalk *et al.* (2011) have explored the technologies and methods by which herders could reduce livestock and make more profits at the same time.

The Chinese government has also implemented policy initiatives to encourage herders to reduce livestock. For instance, households receive a 1.5 RMB/mu (*i.e.* 22.5 RMB/ha) subsidy when they reduce stocking rate to comply with the policy. However, in practice most households still insist their own stocking rate is best, and do not reduce their livestock number. This raises the question of why such policies are commonly resisted by herders. Based on recent literature and field investigation, it is clear that it is their stocking rate and not the policy that guides herders' decisions on how to adjust and manage

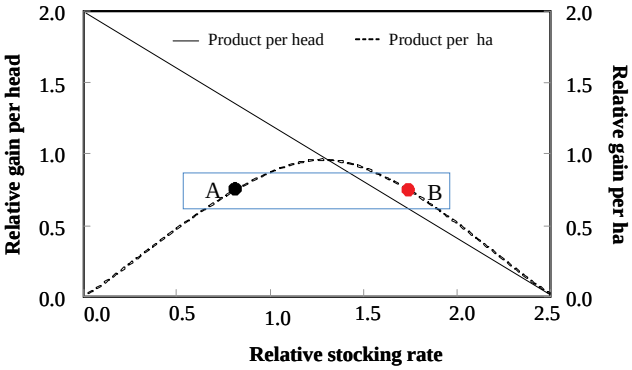

Figure 1. Basic relationships between animal production and stocking rate for grazing livestock following Kemp *et al.* (2011).

their livestock and grassland resources. We proposed the term "mental stocking rate" defined as the number of animals that the herders think they can maintain on a piece of grassland over a specified period of time (Hou *et al.* 2013).

Understanding mental stocking rate

Table 2 shows the indicators for herder judgment and opinion of mental stocking rate. In Xinbaerhu, Xilinhot and Sunite, overall 65%, 61% and 49% of respondents admitted they raise more livestock than when the policy was implemented in these three counties. Three-quarters of herders surveyed hold that their grassland is not overstocked, and 52%, 57% and 63% even thought that their grasslands could still graze more livestock. Surprisingly, 80%, 88% and 76% respondents still insisted that they always took into consideration the grassland carrying capacity when deciding whether to raise more livestock. Herders also nominated reasonable stocking rates in their opinion, were 0.75-1.50 sheep/ha, 0.60-1.50 sheep/ha, and 0.50-0.75 sheep/ha, respectively.

Our survey also revealed that overall 63%, 54% and 50% of herders do not see the need for implementing the policy in these three regions. More importantly, a majority of herders interviewed thought that the current policy was not reasonable and did not conform to the local environmental situation.

Discussion

A majority of herders insisted that grasslands were not overstocked in our study, and most thought that they could raise more livestock without ill-effect. Similar results have been reported in studies by Zhou (2008) and Da and NaRengawa (2011) who argued that their was only moderate overstocking rather than excessive.

These conclusions may be explained by the highly variable climate evident in the large inter-annual fluctuat-

Table 2. Mental stocking rate statement items: prevalence estimates by region

Category	Xinbaerhu (N=51)	Xilinhot (N=58)	Sunite (N=57)
Breeding more livestock than ten years ago	65%	61%	49%
No overstocking on rangeland	74%	79%	68%
Rangeland could still carry more livestock	51%	57%	63%
Always taking into account the carrying capacity of rangeland when deciding whether to breed more livestock	80%	88%	76%
Stocking rates that herders think are reasonable (sheep/ ha)	0.75-1.50	0.60-1.50	0.50-0.75

ion in precipitation. As herders say, the variability in annual precipitation changes rangeland productivity while the policy remains unchanged year after year. If they complied with the policy, grassland resources would be wasted in a good year. When they encounter a bad year with heavy snow or drought, many livestock die or have to be sold cheaply, resulting in a great loss to production which seriously affects the sustainability of the household. If they breed more livestock in a good year, herders could still keep relatively more livestock for recovering production in a relatively short term even when livestock losses are incurred. This explains in part why herders do not comply with the livestock policy, and continue to breed the necessary livestock numbers that in their opinion sustains their livelihood.

Note it does not mean that households are not receptive to new management practices to counter extreme climatic events, such as drought or heavy snow. In 1999-2000, for example, herders of Xilingol League experienced severe drought in summer followed by heavy snow in winter, which killed thousands of livestock. As a result of effective extension programs after this disaster, herders have constructed warm sheds and conserved more forage for use as winter supplement.

Our results also indicated that half of herders felt no need to implement the policy. This reflects the inflexibility of the policy to accommodate variability in seasonal production. In practice, herders appreciate the importance of the animal-grass balance more than anyone else. Some sumu (or district) have modified the policy to suit local conditions, but in the main the policy has remained unchanged for years and does not conform to the actual situation which has meant that herders have maintained their mental stocking rate. These findings are consistent with the conclusion of Zhou (2008) that herders had their "own stocking rate" and took short-term adaptive measures to achieve animal-forage balance. We also found the mental stocking rate guided herders' decisions on the size of livestock herds, the quantities of forage to conserve or buy, and whether to lease additional areas of grasslands. We conclude that since this mental stocking rate is the basis of herder decision behaviour, it is crucial from a policy perspective to explore a bottom-up, adaptive and participatory approach in which the questions and experiences of herders are taken into account to develop a new animal-grass balance policy for sustainable grassland management.

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References

Da L, NaRengawa (2011) Reflection on theory and system of overgrazing in Inner Mongolia. *Northern Economy* **6**, 32-35.

Han GD, Na L, Zhao ML, Zhang M, Wang ZW, Li ZG, Bai WJ, Jones R, Kemp D, Takahashi T, Michalk D (2011) Changing livestock numbers and farm management to improve the livelihood of farmers and rehabilitate grasslands in desert steppe: a case study in Siziwang Banner, Inner Mongolia Autonomous Region. In: DR Kemp and DL Michalk (eds.) Development of sustainable livestock systems on grasslands in north-western China. *ACIAR Proceedings* **134**, 80-96.

Hou X, Han Y, Li FY (2012) The perception and adaptation of herdsmen to climate change and climate variability in the desert steppe region of northern China. *The Rangeland Journal* **34**, 349-357.

Hou XY (2005) 'Grassland ecological construction strategy in China.' (China Agriculture Press: Beijing)

Hou XY, Yin YT, Yun XJ, Li XL, Ding Y (2013) Herders' stocking rates and shift of grass-animal balance model in northern grassland of China. *Chinese Journal of Grssland* **35**, 1-11.

Kemp D, Brown C, Han GD, Michalk D, Nan ZB, Wu JP, Xu Z (2011) Chinese grasslands: problems, dilemmas and finding solutions. In: DR Kemp and DL Michalk (eds.) Development of sustainable livestock systems on grasslands in north-western China. *ACIAR Proceedings* **134**, 12-23.

Kemp D, Michalk, D (2007) Towards sustainable grassland and livestock management. *Journal of Agricultural Science* **145**, 543.

Li B (1999) Steppe degradation in northern China and preventing measures. In 'Collected Papers of Li Bo.' (Ed. RG Xu.) (Science Press: Beijing)

Li WJ, Zhang Q (2009) 'Unscrambling the grassland dilemma: understanding problems of grassland utilization and management in arid and semiarid areas.' (Economic Science Press: Beijing)

Li X, Yuan Q, Wan L, He F (2008) Perspectives on livestock production systems in China. *The Rangeland Journal* **30**, 211-220.

Michalk D, Kemp D, Han GD, Hua LM, Nan ZB, Takahashi T, Wu JP, Xu Z (2011) Re-designing livestock strategies to reduce stocking rate and improve incomes on western China's grasslands. In: DR Kemp & DL Michalk (eds.) Development of sustainable livestock systems on grasslands in north-western China. *ACIAR Proceedings* **134**, pp. 140-151.

Ren JZ, Hu ZZ, Zhao J, Zhang DG, Hou FJ, Lin HL, Mu X (2008) A grassland classification system and its application in China. *The Rangeland Journal* **30**, 199-209.

Takahashi T, Jones R (2011) 'Steady-state modelling for better understanding of current livestock production systems and exploring optimal short-term strategies. In 'Development of sustainable livestock systems on grasslands in north-western China', ed. by DR Kemp and DL Michalk, ACIAR Proceedings.'

Waldron S, Brown C, Longworth J (2010) Grassland degradation and livelihoods in China's western pastoral region: A framework for understanding and refining China's recent policy responses. *China Agricultural Economic Review* **2**, 298-320.

Wang H (2010) There is no one-size-fits-all policy for grassland management. *China Science Daily*. Beijing.

Yang L and Hou XY (2005) Reflection of the forage-livestock balance modes. *Chinese Rural Economy* **9**, 62-66.

Zhou SK (2008) Rangeland resources: Use and management from a herder perspective. *Agricultural Economy* Volume 43-45.